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Multi-stress effects on honey bee colonies

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Conclusions

- *Varroa destructor* is the most lethal stressor at colony level compared to field realistic exposures to *Nosema* and *Imidacloprid*
- The honey bee superorganism may well be able to compensate at colony level for negative effects of stressors on its individuals

Background

High losses of honey bee colonies are of great societal concern. *Varroa destructor* infestation is acknowledged as an important cause of these losses. Multi-stress effects with field realistic exposures on honey bee colonies are however still hardly studied.

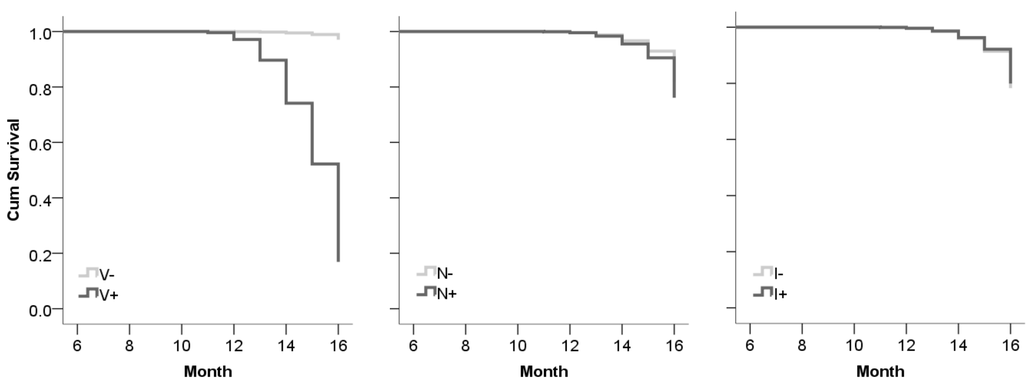
Objective

In this study we investigated the interacting effects of field-realistic multi-stress exposure on:

- Survival of honey bee colonies
- Colony size over time and flight distance (as proxies for performance)

Results colony survival

- 70-80% of the colonies died during winter, no interactions between the stresses were found
- *Varroa* field-realistic exposed colonies were 59 times more likely to die than treated control colonies (P<0.001)
- *Nosema* field-realistic exposed colonies were 1.4 times more likely to die than treated control colonies (P=0.04)
- Field-realistic exposure to *Imidacloprid* did not result in differences in survival between exposed and control colonies (P=0.55)



Survival plots (fraction colonies alive) for *Varroa* (V, left), *Nosema* (N, centre), or *Imidacloprid* (I, right) in the months June to April, for field realistically exposed (+) and control (-) groups

Method

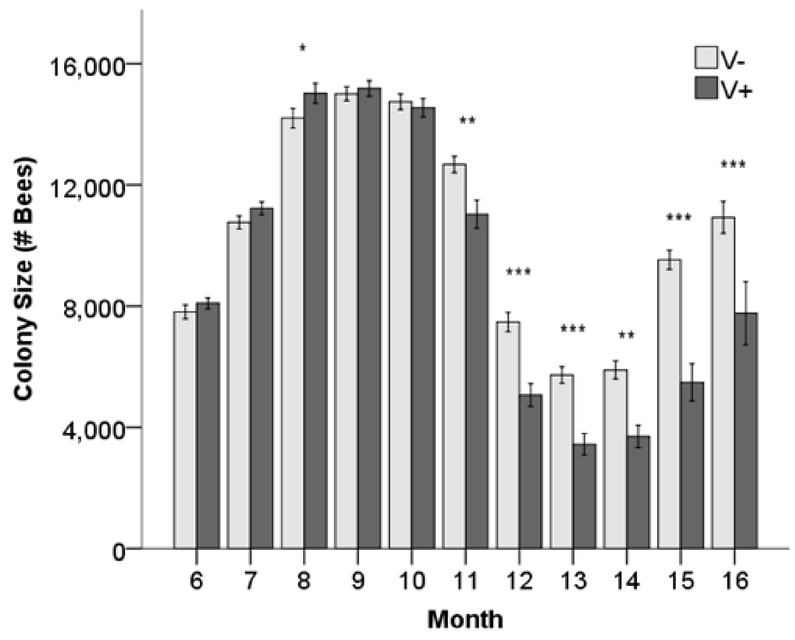
Field-realistically exposure in a 2x2x2 design with:

- *Varroa destructor* (not treated vs. treated control)
- *Nosema* spp. (not treated vs. treated control)
- *Imidacloprid* (6ug/L vs. control in sugar water; 660ml/week, 12 weeks)

- N=10 colonies per group
- Repeated for 2 years, new colonies in second year
- Pollen foragers from *Varroa* and *Imidacloprid* (and their control) groups were collected and tested in a tethered flight mill

Results colony size

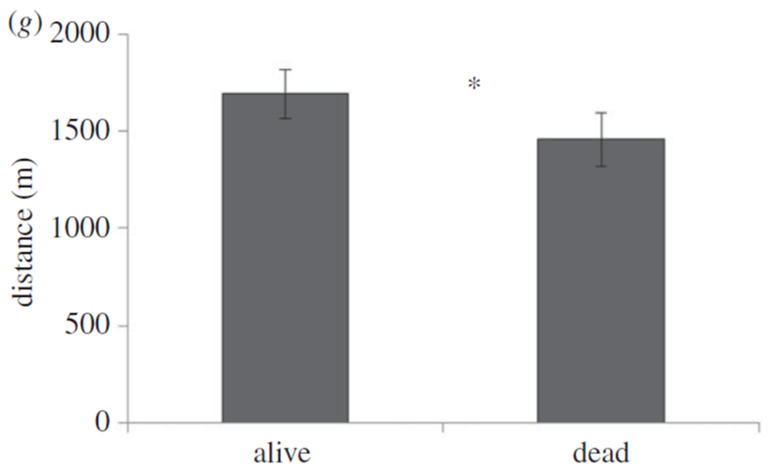
- No interaction effect between the stresses was found for differences in colony size
- Colonies field-realistically exposed to *Varroa* were 13% smaller than control colonies. *Nosema* colonies were 2.5% smaller. No effect on colony size was found for field realistic *Imidacloprid* exposure



Colony size for the single stressor Varroa as function of months June – April

Results flight performance

- Colonies exposed to field realistic levels of both *Varroa* and *Imidacloprid* flew far less compared to any other group (P<0.001), even though no interactive effects on colony size or survival were found
- Foragers from colonies that died during the winter flew only 75% of the distance that bees from surviving colonies flew during the preceding autumn (P=0.03)



Flight distance in autumn of foragers of colonies that either survived or died in winter

References

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Blanken, L. J., van Langevelde, F., & van Dooremalen, C. (2015). Interaction between *Varroa destructor* and imidacloprid reduces flight capacity of honeybees. Proceedings of the Royal Society B: Biological Sciences, 282(1820), 20151738.

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